

VI. ADDITIONAL RESEARCH NEEDS

During the process of creating this guidance document, the Coastal Commission staff identified areas where additional research is needed to help understand and prepare for sea-level rise. The research needs are directed toward research institutions at academic, state, federal, and local levels. The Commission will strive to collaborate with and support research related to sea-level rise science and adaptation.

1. **Improved estimates of local vertical land motion.** Several independent processes – glacial isostatic rebound, groundwater withdrawals, plate movements and seismic activity – influence vertical land motion. Current guidance on sea level projections adjusts for large-scale vertical land motion north and south of Cape Mendocino. These adjustments do not properly address locations that are moving differently from the region, such as Humboldt Bay. A peer-reviewed methodology is needed to determine:
 - a. Instances when it will be important to modify the regional sea-level rise projections for local vertical land motion,
 - b. Types of existing information on land motion (tide gauge records, satellite data, land-based GPS stations, etc.) that provide the best estimates of local land trends,
 - c. A procedure for adjusting state or regional sea-level rise projections for sub-regional or local conditions, and
 - d. Additional data that are needed to implement this procedure.
2. **Analysis of sea-level rise impacts to coastal access and recreation.** To improve public access planning efforts, more information is needed about how sea-level rise could affect public access areas and recreation throughout the state, including changes to waves and surfing, and the potential economic costs of these impacts. Many currently accessible beach areas have the potential to become inaccessible due to impacts from sea-level rise. Shoreline armoring and emerging headlands could isolate connected beaches with sea-level rise, which will block lateral access. Rising sea level will also tend to constrict beaches that are prevented from migrating landward by shoreline armoring and development. Some blufftop trails will become inaccessible as segments of trail are lost to erosion. In addition, changes in beach conditions due to sea-level rise could affect waves and surfing. Research on the specifics of these impacts will help the Commission and others understand the details of the potential impacts to coastal access and recreation.
3. **Methods to evaluate impacts to coastal resources from shoreline protection.** Research is needed to develop and improve methods to evaluate and mitigate for the adverse impacts to recreation, public access and beach ecology from shoreline armoring projects. This information will be used to determine a set of mitigation options that may be considered for use when evaluating individual permit applications to offset anticipated losses to beach ecology and resources caused by shoreline armoring projects. The Coastal Commission staff is currently working on developing resource valuation guidelines as part of a Project of Special Merit (see Next Steps, Additional Items).
4. **Analysis of sea-level rise impacts to wetlands and strategies for preserving wetlands throughout the state.** Additional research is needed to assess the vulnerability of wetlands

and other sensitive habitat areas to climate change, and to identify adjacent areas that may be important for future habitat migration (e.g. wetland transitional areas). Further work is also needed to develop management strategies that are adaptable to local wetland conditions and sea-level rise impacts, such as the following:

- a. Methodologies for establishing natural resource area buffer widths in light of sea-level rise,
 - b. Approaches for identifying and protecting migration corridors,
 - c. Guidance for increasing wetland sediment supply and retention,
 - d. Techniques for developing an adaptive wetland restoration plan, and
 - e. Monitoring criteria.
5. **Assessment of coastal habitat vulnerability to sea-level rise and other climate change impacts.** In addition to research on wetland migration potential, further research is needed to identify the coastal habitats that are most likely to experience adverse impacts from sea-level rise and extreme storms. Research is also needed to identify strategies to ameliorate the vulnerabilities.
 6. **Baseline data and monitoring of sea-level rise impacts.** Baseline monitoring data is needed for coastal and near-shore waters, beaches, bluffs, dune systems, near-shore reefs, tide pools, wetlands, and other habitat areas to better understand these systems, monitor trends and detect significant deviations from historic conditions that may be related to sea-level rise and other aspects of climate change.
 7. **Methods for estimating change in erosion rates and shoreline change due to future sea-level rise.** There is a need for a peer-reviewed methodology for estimating change in erosion rates due to sea-level rise for bluffs, beaches, and other shorelines exposed to erosion.
 8. **Potential effects of sea-level rise on coastal aquifers.** Additional research is needed to quantify the potential effect of sea-level rise on freshwater aquifers located along the California coast, and the degree to which sea-level rise could lead to new incidences of intrusion. Research on aquifers should include: (a) an evaluation of the potential incidence and severity of saltwater intrusion at the scale of individual aquifers, under various sea-level rise scenarios, and (b) criteria to use when deciding if saltwater intrusion requires mitigation or response.